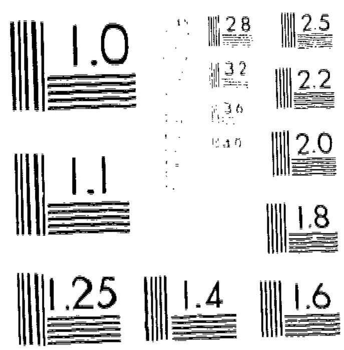

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ABSTRACT

Types of land-use issues which form current problems in urban areas are discussed in this paper. The majority of these environmentally based issues revolve around the management of water. The five most often encountered water-oriented issues are denoted in rank order of importance. First, an ample water supply which is free from contamination must serve as a finite limit on municipal growth. Second, sewage disposal needs to be provided by on-site systems such as septic disposal and spray irrigation or by off-site systems such as lagooning, small package plants, or large regional sewage treatment plants. Third, storm runoffs, generated by development, need to be controlled. Fourth, erosion and sedimentation, occurring at an enormously accelerated rate due to the activity of man, need to be managed. Fifth, flood plains must be managed, which becomes increasingly necessary as each new structure built in the flood plain obstructs the stream flow and reduces the area available to the stream to convey flood waters. The pervasiveness of water as an element in land-use issues necessitates rational management of the hydrologic cycle in a reasonable urban planning goal. (Author/DB)

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THE MAJOR ENVIRONMENTALLY-BASED LAND USE ISSUES ON THE URBAN FRINGE

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An examination of the major environmentally-based land use issues in metropolitan areas reveals that the majority of them revolve about the management of water. For a variety of reasons, water-related activities stand in the forefront of controversy and concern in the developing suburban areas. At the same time, the need for reliable data to help resolve the planning issues is also apparent. Thus, the purpose of this paper is to discuss the types of land use issues which form current problems and the associated data requirements.

1. WATER SUPPLY

An ample supply of fresh, potable water is of obvious importance to a community. The adequacy of such supplies has generally been taken for granted in humid areas (1). Yet system failures, aquifer overpumping, and present and potential instances of surface and ground water contamination indicate that the provision of potable water for a community is the number one issue.

The first question is whether or not the water supply for a development will be onsite or offsite. If the former, will the underlying geologic formation be sufficient for the planned density? Estimates of ground water yields for different geologic formations are now becoming available as first approximations for planning purposes, particularly if the estimates are buttressed by numerous well records. The adequacy of geologic mapping at the right scale is of concern, especially if the planning is to be done at the local or regional level. Many geologic maps are at the 1:250,000 scale or smaller which is inappropriate for local planning.

If the water supply will be offsite, will the purveyor have ample endogenous supplies or must exogenous sources, in terms of the municipality, be tapped? More and more municipalities are competing for the same sources of water as they exhaust local supplies and reach further and further afield.

Density Limitations

As a general planning matter, available water supply should serve as a finite limit on municipal growth and development. Going further, there are sound, ecologically rational reasons to consider severe limitations on density for purposes of water supply. First of all, a community may be located in a headwaters region which is the supply source for potable water downstream. High density building with its commensurate proportion of impervious cover leads almost automatically to increased runoff rates and volumes in the absence of performance standards (5). That much less water will be available in the "sponge" or ground of the headwaters area to sustain the base flow of the stream system. Does the upstream community have the responsibility to maintain the watershed so as to protect the interests of downstream communities? From a regional perspective, it makes sense to acknowledge the water supply function of a headwaters area. Therefore, density limitations in headwaters communities would appear to be reasonable, inasmuch as the interests of many people would be affected.

2. SEWAGE DISPOSAL

The provision of adequate wastewater facilities is another obvious necessity for any new development. A number of options are available to a builder in order to provide adequate sewage disposal. For example, the builder could go to onsite systems, such as septic disposal and spray irrigation, or to offsite systems, such as lagooning, small package plants, or larger regional sewage treatment plants.

Each of the alternatives have advantages and disadvantages. The septic system is one of the simplest methods, but will only work well when the receiving soils possess the right texture, slope and infiltration characteristics. Soil survey maps at a scale of 1:20,000 or larger can be used to delimit zones that have slight, moderate or severe limitations to septic disposal. Soils information is also important for effective operation of lagoons or stabilization ponds and for spray irrigation of treated effluents which use the soil as a living filter.

Large regional treatment plants are often favored by regulatory bodies because of their ease of administration, economies of scale, and better engineering staffs. However, regional plants can have a negative impact on a watershed if there is a breakdown which can result in large quantities of raw sewage entering the stream system at one point. Regional plants also require long and expensive interceptor sewers which act as a magnet for additional development, particularly if the interceptors traverse open land (4).

The indirect but effective use of building moratoriums as a planning device, because the sewage treatment plant is overloaded, is a related issue. Nearly 100 communities in New Jersey have been under some form of bar recently, resulting in either no development or a reversion to septic disposal.

3. STORM WATER MANAGEMENT

Storm water management includes the engineering structures and administrative regulations that control the quantity and quality of storm runoff that is generated by development. One goal in storm water quantity management is to ensure that post-development peak runoff should not exceed pre-development peak runoff even though there is an increase in impervious cover. Several structural techniques which will aid in this objective include detention and retention basins, findams, Dutch drains, porous paving, and recharge basins (6). Depending upon local circumstances, all of these techniques have their utility.

Another related issue in storm water quantity management is what formula to use to describe the relationship between rainfall and peak runoff. There are a number of empirical runoff formulas which have been used for years with reasonable success; the assumptions vary within and among the formulas. However, some standardization would be desirable so that there would be at least a common denominator in design practice.

The possibility that the rainfall intensity values which are used in the runoff formulas may not reflect more recent storms of greater intensity must also be noted. The frequency analysis of rainfall data may include only a limited portion of the historical record and therefore bias the results.

Nonpoint Source Pollution

Increasing evidence from a number of studies in recent years has led to the somewhat

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startling realization that the pollutional load carried in storm water runoff can equal or exceed that found in residential sewage (8,9). This means that urban area runoff could be highly contaminated. The first flush is usually the worst, i.e., the bulk of the pollutional load is carried during the first hour of storm runoff. Density and land use type are critical variables in determining the amount of urban pollution runoff.

The implications of the magnitude of this nonpoint source pollution are serious. The quality of the watercourses will continue to be degraded even as new sewage treatment plants are built or older ones are expanded and modernized.

4. EROSION AND SEDIMENTATION MANAGEMENT

Erosion and sedimentation have been going on for millions of years before the advent of man. This natural rate of erosion is called the "geologic norm." What has occurred with the activities of man, however, is an enormously accelerated rate of erosion that presents land use management problems (3,7).

The essence of the erosion and sedimentation problem is that removal of the plant cover on any soil will result in the removal of the soil particles by the agents of erosion. The resulting sediment causes problems downstream, smothering benthic organisms on the stream bed and thereby damaging aquatic life. Sediment is considered a pollutant, and the problem appears to be getting worse.

Highly erodible soil is the first indicator of a potential problem. Soils differ in their susceptibility to erosion, and this difference is denoted by "K" values which are available for each soil type. By having detailed maps at the scale of 1:20,000 or larger showing the location of the highly erodible soils, local planning authorities would be in a good position to be aware of potential problems in certain areas.

Steep Slopes

Slope provides another indicator of a potential problem. Other things being equal, sediment runoff increases as the slope increases. However, slope increase and sediment runoff increases are not proportional, i.e., if you double the slope, the sediment increase more than doubles.

Steep slopes are critical resource areas and development on them should be discouraged. As a rough rule of thumb, slopes between 10-25% are marginal for development and stringent design guidelines are required. Development should be prohibited on slopes in excess of 25%.

5. FLOOD PLAIN MANAGEMENT

If all flood-prone lands were undeveloped, flood losses would be minimal. Thus, one simplistic but effective procedure to eliminate flood losses would be to clear everybody out of the flood plain. Indeed, in many cases it would be cheaper to society to buy up homes in the flood plain and relocate the residents on higher ground than invest in more flood control

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structures that only create the illusion of comparative safety until the next storm of sufficient intensity comes along.

Be that as it may, flood plains are, and have been for hundreds of years, attractive because of their rich soils, flat slopes, and locational advantages (10). Development in the flood plain is not only subject to possible flood damage itself but also increases the potential damage to others. For example, road grading and building construction changes the vegetation or topography which increases runoff. Channel obstruction causes an increase in flood elevations immediately upstream from the obstruction. A similar increase in flood heights may occur immediately downstream of channel enlargement sections. Every and any new structure built in the flood plain and especially the floodway will obstruct streamflow and reduce the area available to the stream to convey the flood waters. The same amount of flood runoff will have to go by, and if there are enough obstructions (buildings, etc.), the water will simply have to rise higher, and it does.

Even though the aforementioned information has been known for decades, it has apparently not deterred continued development in the flood plain. Since federal flood control measures of a structural nature (dams, levees, etc.) began in the United States in 1936, the residual annual flood damage has always matched or exceeded the annual flood control expenditures. What is worse is that the damages continue to grow even as new funds are poured into structural works.

What is called for is greater attention to nonstructural measures, particularly zoning. The federal Flood Insurance Program is a step in the right direction which will at least ensure that communities will be notified what lands within their borders are flood-prone. Two problems (mentioned next) are associated with the insurance program: 1) the mode of flood plain delineation, and 2) the selection of a recurrence interval.

Flood Plain Delineation

For purposes of regulation, it is necessary to delineate the flood plain on a map of appropriate scale. A variety of methods can be used for delineation, of which the most common are listed below (11).

1) Flood profile and backwater curve - this is the most detailed and presumably the most accurate method. It requires detailed topographic information and ground surveys and is therefore the most expensive per river mile (km).

2) Soils - this method associates flood-prone areas with alluvial deposits laid down by a stream. It is a fast, inexpensive method which is based on previously prepared detailed soils maps. The problem with the soils method is that soils and flood heights may not correlate and that alluvial soils, which were deposited over hundreds and thousands of years, may not reflect present conditions in the watershed. Also, some studies suggest that alluvial soils are associated with a recurrence interval of 40 years which is less than the 100 year frequency used by the U.S. Federal Insurance Agency.

3) Topographic – this method is based on using topographic maps and then selecting those land areas adjacent to stream channels which are flat. This is a fast, inexpensive method which has been used by the U.S. Geological Survey to provide interim flood plain maps. A problem arises with the contour interval used. Most of the 1:24,000 topographic maps in the U.S. have contour intervals of 10 and 20 feet (3 and 6 m) or even larger, which is coarse. It is possible to have special topographic maps made with a contour interval of 2 feet (0.6 m). This requires aerial overflights at the right season and is quite expensive.

In sum, the soils and topographic methods can be used as interim measures for flood plain delineation until such time as more funds are available to use the flood profile and backwater curve method.

Recurrence Interval

The recurrence interval is the average period of time within which a given flood will be equalled or exceeded once. The U.S. Federal Insurance Administration uses the 100-year storm for flood hazard area design. An interesting question that comes up is whether this policy will indirectly foster development in that portion of the flood plain that is just above the delineation defined with a 100-year recurrence interval. This is a complex matter, as it involves the determination of extreme meteorological events which is fraught with uncertainty and the exactitude of flood hazard area mapping.

6. OTHER ISSUES

Other planning issues include a) solid waste disposal which is closely related to ground and surface water contamination, b) wildlife with the need for habitat preservation and the maintenance of minimum undeveloped space for different species, c) unique natural, historic and archaeological sites, and d) open space preservation which includes the preservation of prime agricultural lands. It is recognized, of course, that many of these planning issues contain interrelated elements. However, this does not negate their individual importance as many local and regional authorities may wish to adopt model ordinances which reflect upon each of the planning issues (2).

7. SUMMARY

The five major environmentally-based land use issues in developing communities on the urban fringe are denoted in rank order of importance as follows: 1) Water Supply; 2) Sewage Disposal; 3) Storm Water Management; 4) Erosion and Sedimentation; and 5) Flood Plain Management.

The pervasiveness of water as an element in these issues is readily apparent. It is also apparent that a reasonable planning goal entails rational management of those portions of the hydrologic cycle that are elements in these planning issues.

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